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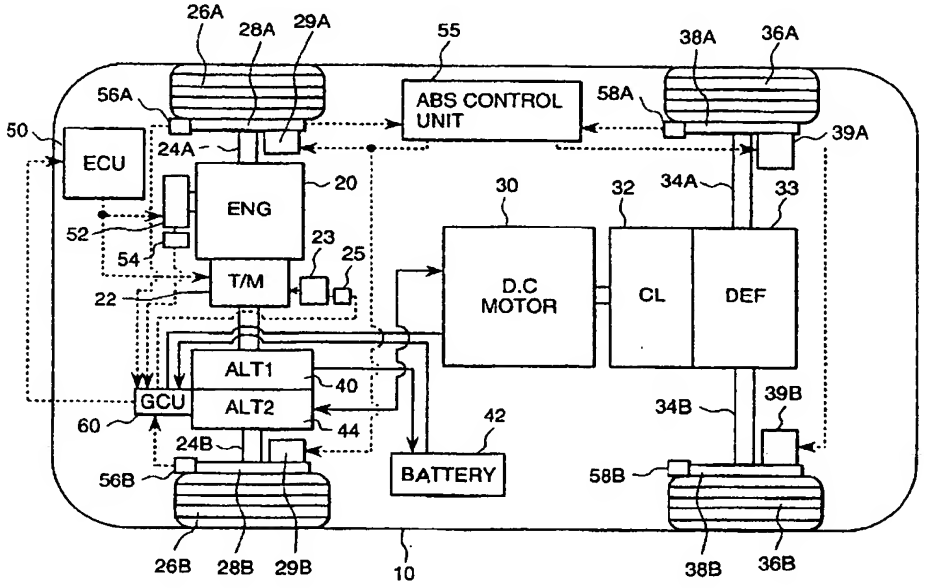
(54) Electric generating system for automobiles and its control method

(57) The present invention relates to a vehicle driving apparatus capable of providing a sufficient driving force. A driving high-power generator (44) is driven by an engine (20). A DC motor (30) is driven directly by energy from the generator (44). A driving generator output voltage control circuit (60) controls output voltage of the generator (44) in accordance with the demanded driving force from the vehicle (10) to control the motor (30).

FIG. 1



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Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a vehicle driving apparatus for driving four wheels of the vehicle using an engine and an electric motor.

[0002] The conventional vehicle driving apparatus has been known, for example, from JP-A No. Hei 9-2090 (published in 1997), wherein a driving battery is utilized, and only at a low μ road for which start assistant is necessary, a 12-V alternator and a 12-V battery for ancillaries are combined to operate a motor. Further, as is known, for example, from JP-A No. Hei 7-231508 (published in 1995), which discloses a system for driving a motor in combination with a 12-V alternator and a 12-V battery for ancillaries.

[0003] However, the conventional system having, as a power source, a 12-V generator and a 12-V battery for ancillaries has a problem that electric energy that can be brought from the 12-V battery (for ancillaries) is small, and the period used for 4WD running is limited so that for the continuous up-hills, high power need be supplied for a long period of time, failing to exhibit sufficient performance.

[0004] It is an object of the present invention to provide a vehicle driving apparatus capable of providing the sufficient driving force.

SUMMARY OF THE INVENTION

[0005]

(1) To achieve the aforementioned object, the present invention provides a vehicle driving apparatus comprising: a first generator driven by an internal combustion engine, the first generator being provided separately from a second generator for ancillaries for supplying electric power to ancillaries of the vehicle; a motor directly driven by energy from the first generator; and control means for controlling output voltage of the first generator in accordance with a driving force requested from the vehicle to control the motor, wherein one wheels of front wheels and rear wheels of the vehicle are.driven by the Internal combustion engine while the other wheels of the front wheels and the rear..wheels of the vehicle are driven by the motor.

With the constitution as described above, the exclusive-use generator and motor are used to obtain the sufficient driving force.

(2) Preferably, electric power supplied to the motor is supplied only from output of the first generator.

(3) Preferably, output voltage of the first generator is controlled by field current control of the first generator to control a driving force generated by the motor.

(4) Preferably, when electric power is not supplied to the motor, the first generator supplies electric power to other electric loads.

BRIEF DESCRIPTION OF THE DRAWUBGS

[0006]

FIG. 1 is a system constitutional view showing the whole constitution of a 4-wheel drive vehicle using a vehicle driving apparatus according to one embodiment of the present invention;

FIG. 2 is a block diagram showing the constitution of the vehicle driving apparatus according to one embodiment of the present invention;

FIG. 3 is a system block diagram of a control system for the vehicle driving apparatus according to one embodiment of the present invention; and

FIG. 4 is a characteristic view of a high-power generator used in the vehicle driving apparatus according to one embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0007] The constitution and operation of the vehicle driving apparatus according to one embodiment of the present invention will be described hereinafter with reference to FIGS. 1 to 4.

[0008] First, the whole constitution of a 4-wheel drive vehicle using a vehicle driving apparatus according to one embodiment of the present invention will be described with reference to FIG. 1.

[0009] FIG. 1 is a system constitutional view showing the whole constitution of a 4-wheel drive vehicle using a vehicle driving apparatus according to one embodiment of the present invention.

[0010] A 4-wheel drive vehicle 10 is provided with an engine 20 and a DC motor 30. The driving force of the engine 20 is transmitted to front wheels 26A, 26B through a transmission 22 and first axles 24A, 24B to drive the front wheels 26A, 26B. The driving force of the DC motors 30 is transmitted to rear wheels 36A, 36B through, a clutch 32, a differential gear 33 and second axles 34A, 34B to drive the rear wheels 36A, 36B. When the differential gear .33 and the clutch 32 are connected, the rotating force of the DC motor 30 is transmitted to rear wheel axles 34A, 34B through the clutch 32 and the differential gear 33 to drive the rear wheels 36A, 36B. When the clutch 32 is disengaged, the DC motor 30 is mechanically separated from the rear wheels 36A, 36B, so that the rear wheels 36A, 36B do not transmit the driving force to the road surface. For the DC motor, for example, a DC shunt-wound motor which is easily switched from a forward operation to a reverse operation and vice versa or a separately excited DC motor is used.

[0011] While in the foregoing, a description has been made of the 4-wheel drive vehicle in which the front

wheels 26A, 26B are driven by the engine 20, and the rear wheels 36A, 36B are driven by the DC motor 30, it is noted that the front wheels may be driven by the DC motor, and the rear wheels may be driven by the engine, and further, it can be also applied to vehicles in excess of 6-wheel such as a truck, and traction vehicles such as a trailer.

[0012] Within the engine room are arranged a generator for ancillaries (ALT1) 40 for performing normal charging and generation system and a battery for ancillaries 42, and output of the generator for ancillaries 40 belt-driven by the engine 20 is stored in the battery for ancillaries 42. Further, a driving high-power generator (ALT2) 44 belt-driven by the engine 20 is disposed in the vicinity of the generator for ancillaries 40. The DC motor 30 is driven by output of the driving high-power generator 44. The generator 40 is, for example, a general generator of about 12V, 2kW, and the driving high-power generator 44 is a generator capable of obtaining higher power than that of the generator for ancillaries 40, for example, a generator of about 36V, 6kW.

[0013] Output of the engine 20 is controlled by an electronically controlled throttle valve 52 driven by a command issued from an engine control unit (ECU) 50. The electronically controlled throttle valve 52 is provided with an accelerator opening-degree sensor 54 to detect an opening-degree of the accelerator. Where an accelerator pedal of a mechanical link and a throttle valve are used in place of the electronically controlled throttle valve, an accelerator opening-degree sensor can be provided on the accelerator pedal. Further, ECU 50 controls the transmission 22. The transmission 22 is an automatic transmission, which is automatically controlled so as to provide a gear ratio selected by a selection lever 23. The position of the selection lever 23 is detected by a gear position detection sensor 25. It is noted that the transmission 22 may be a manual transmission.

[0014] Brakes 28A, 28B, 38A and 38B provided on the front wheels 26A, 26B and the rear wheels 36A, 36B, respectively, are provided with anti-lock brake (ABS) actuators 29A, 29B, 39A and 39B controlled by an anti-lock brake (ABS) control unit 55. Further, the front wheels 26A, 26B and the rear wheels 36A, 36B, respectively, are provided with rotation sensors 56A, 56B, 58A and 58B for detecting the rotational speed and the rotational direction. The rotation sensors 56A, 56B, 58A and 58B are provided every wheel, but may be disposed on one of or both the front wheel axle and the rear wheel axle.

[0015] A driving generator output voltage control circuit (GCU) 60 calculates vehicle speeds on the basis of the rotational speed of the wheels 26A, 26B, 36A and 36B detected by the rotation sensors 56A, 56B, 58A and 58B, and controls the driving high-power generator 44 and the DC motor 30 on the basis of the calculated vehicle speeds. The details of the control by the GCU 60 will be described referring to FIG. 3.

[0016] In the following, the constitution of the vehicle driving apparatus according to the present embodiment will be described with reference to FIG. 2. FIG. 2 is a block diagram showing the vehicle driving apparatus according to one embodiment of the present invention, showing an example of circuits for power supply and controls. The same reference numerals as those of FIG. 1 indicate the same parts. In the figure, with respect to the connection between the blocks, the solid line indicates a connection of power supply, and the broken line indicates a connection for controls. Input into an output voltage control circuit for a driving generator (GCU) 60 are information on the rotational speed and rotational direction of the wheels 26A, 26B, 36A, 36B detected by the rotation sensors 56A, 56B, 58A and 58B, information on an accelerator opening-degree detected by the accelerator opening-degree sensor 54, and information on the gear position detected by the gear position detection sensor 25.

[0017] GCU 60 outputs the command value of output voltage to the driving high-power generator (ALT2) 44 to control the output voltage of the high-power generator 44 so that the DC motor 30 is controlled. GCU 60 controls a field current to flow into a field winding 31 of the DC motor 30 so as to directly control the DC motor, thus improving the lowering of response resulting from that the DC motor 30 is controlled by the high-power generator 44.

[0018] The driving generator output voltage control circuit (GCU) 60 is provided with an I/O circuit 61, an A/D converter 62, a micro processor (MPU) 63, an I/O circuit 64, a H bridge driver 65 and a H bridge circuit 66. Gear position information detected by the gear position detection sensor 25 is fetched into the MPU 63 through the I/O circuit 61. Information of the rotational speed and rotational direction of the wheels 26A, 26B, 36A, 36B detected by the rotation sensors 56A, 56B, 58A and 58B, and information of an accelerator opening-degree detected by the accelerator opening-degree sensor. 54 are fetched into the MPU 63 through the A/D converter 62. The MPU 63 is provided with a memory for holding programs and data for controlling the CPU and the motor, calculates vehicle speeds in accordance with the input information, calculates . output voltage value of the driving high-power generator 44 to supply it from the I/O circuit 64 to the driving high-power generator (ALT2) 44, to control the output voltage value generated. The MPU 63 regulates a field current flowing into the field winding 31 of the DC motor 30 in the H bridge circuit 66 through the H bridge driver 65. When the vehicle is moved back, a field circuit is caused to flow in the direction opposite to that of the forward operation by the H bridge circuit 66 to obtain the reverse driving force similar to that of the advance of the vehicle. Further, the MPU 63 produce connection and disconnection signals for the clutch 32 to feed it from the I/O circuit 64 to the clutch 32.

[0019] While in the foregoing, each sensor signal is directly input into the driving generator output voltage

FIG. 1

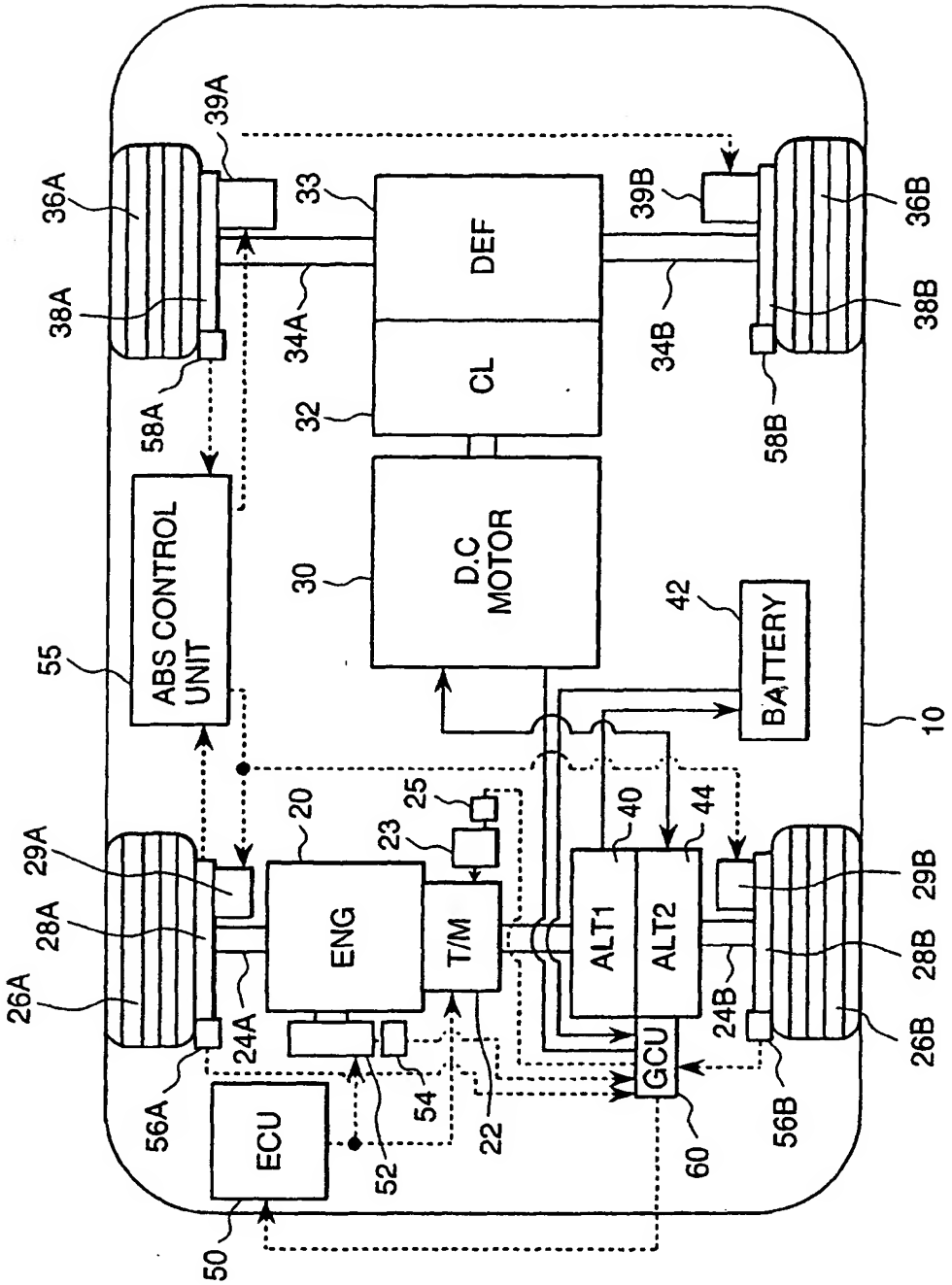


FIG. 2

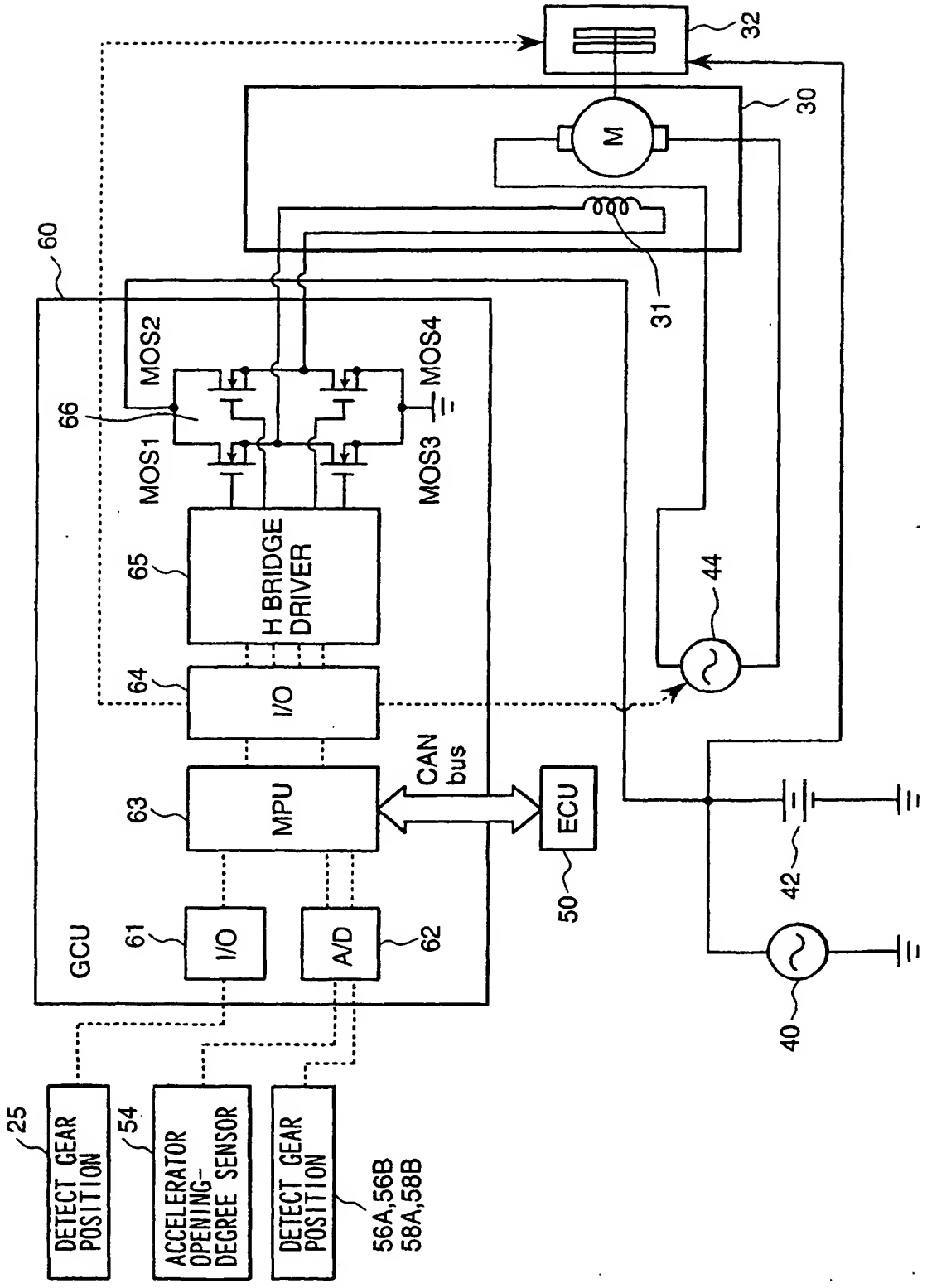


FIG. 3

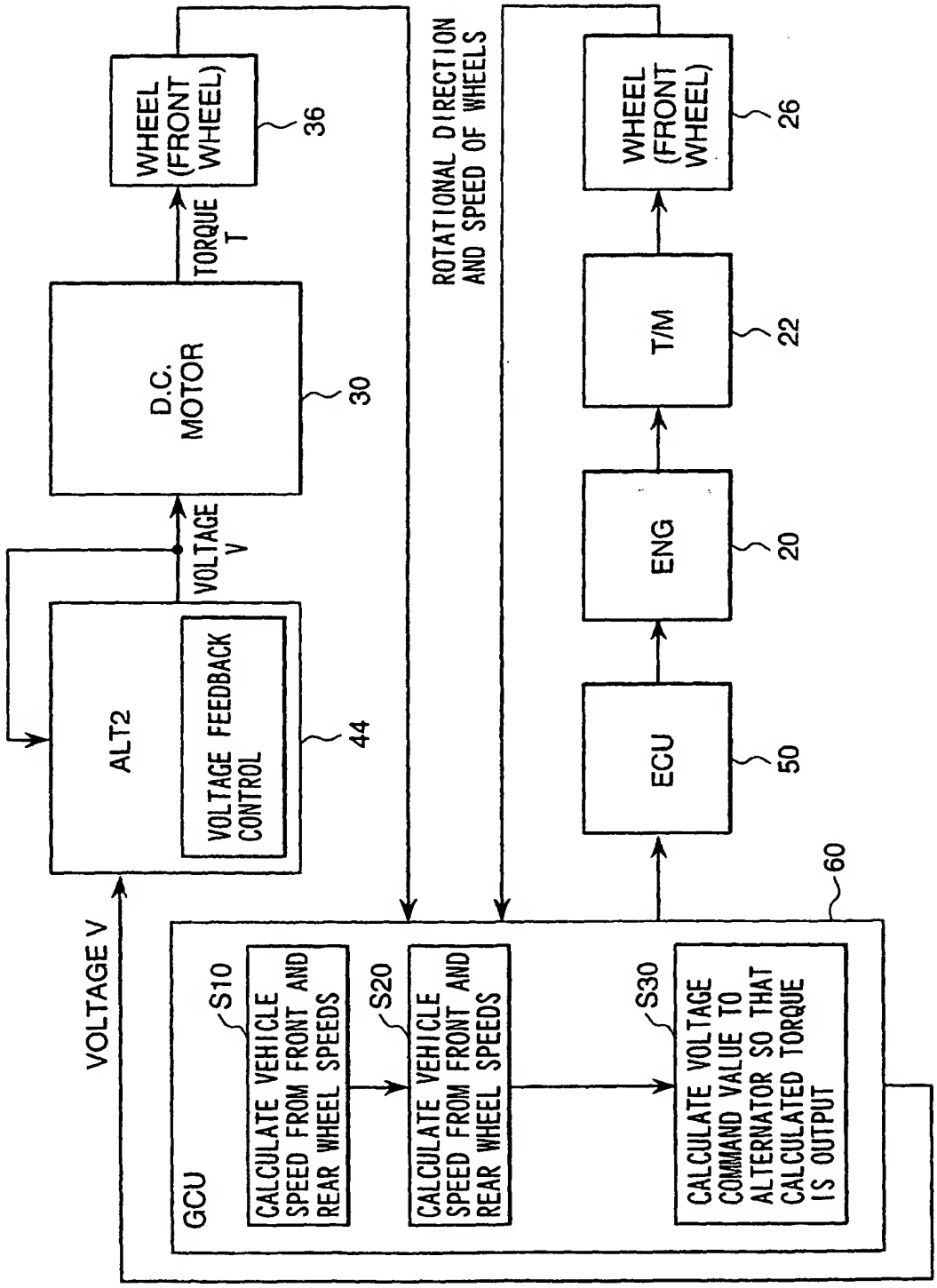
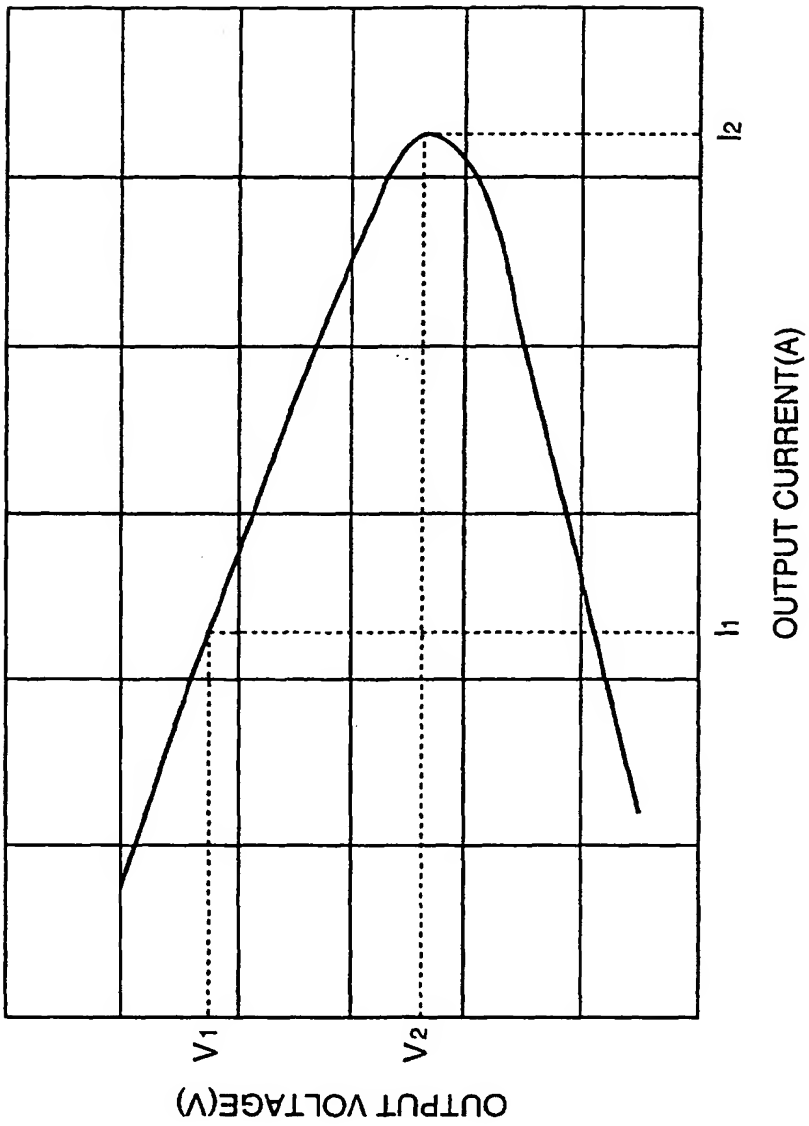


FIG. 4



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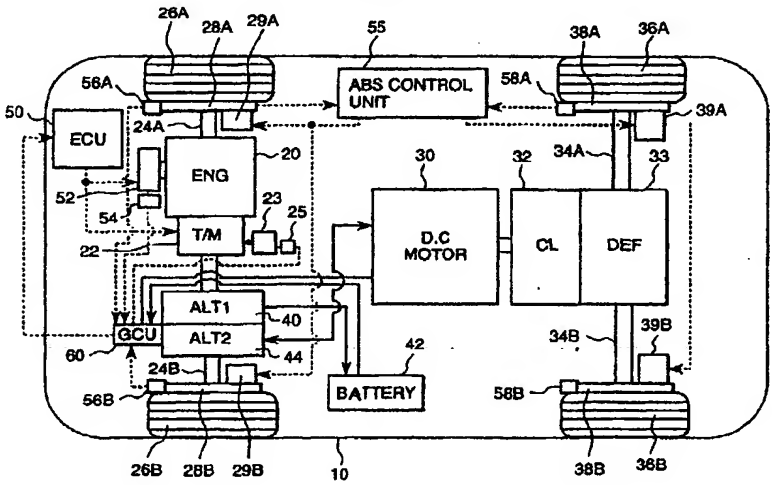

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EUROPEAN SEARCH REPORT

Application Number
EP 01 10 4408

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TECHNICAL FIELDS SEARCHED (Int.Cl.7)

B60L
B60K

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	28 January 2002	Hascher, T

CATEGORY OF CITED DOCUMENTS

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